IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of: Brinkerhoff et al.

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Application No.: NEW

Examiner: UNASSIGNED

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Title: TECHNIQUE FOR IMPLEMENTING FRACTIONAL INTERVAL TIMES FOR FINE GRANULARITY BANDWIDTH ALLOCATION

PRELIMINARY AMENDMENT

Commissioner for Patents
Washington, D.C. 20231

Dear Sir:

Before examination on the merits, please amend the subject patent application as follows.

In the Specification:

Page 8, line 10, please change "idel" to --idle--.
A replacement page is submitted herewith.

In the Claims:

Please cancel claims 40-68, and add the following new claims 69-94:

--69. A scheduler for scheduling data parcels from at least one client process to be output for transmission over a first communication line, the first communication line having an associated first bit rate, the at least one client process including a first client process having an associated second bit rate;

the scheduler being adapted to identify incoming client data parcels from the first client process, and to generate an output stream of data parcels to physical layer logic for transmission over the first communication line;

the scheduler being configured or designed to generate filler data parcels which include non-meaningful data.

70. The scheduler of claim 69 wherein the scheduler is devoid of an internal clock source.

71. The scheduler of claim 69 wherein the scheduler includes an ATM cell switch.

72. The scheduler of claim 69 further comprising:

quality of service (QoS) scheduling logic;

ratio computation component (RCC) logic in communication with the QoS scheduling logic, the RCC logic being configured or designed to compute an appropriate ratio of meaningful data parcels to non-meaningful data parcels.

73. The scheduler of claim 69 being further configured or designed to identify a plurality of client data parcels associated with the first client process;

the scheduler being further configured or designed to schedule selected client data parcels to be included in an output stream to be provided to physical layer logic for transmission over the first communication line;

the scheduler being further configured or designed to determine an appropriate ratio of filler data parcels to be inserted into the output stream, said filler data parcels including non-meaningful data; and

the scheduler being further configured or designed to generate the output stream;

wherein the output stream includes client data parcels and filler data parcels.

74. The scheduler of claim 73 wherein said determine means includes the scheduler being further configured or designed to determine an appropriate ratio of filler data parcels to be inserted into the output stream to thereby cause a bit rate of the output stream to be substantially equal to the first bit rate.

75. The scheduler of claim 69 wherein the output stream includes a uniform pattern of client data parcels and filler data parcels.

76. The scheduler of claim 69 wherein the output stream includes a uniform pattern of client data parcels and filler data parcels; and

wherein the scheduler further comprises repeating the uniform pattern of client data parcels and filler data parcels on a periodic basis.

77. The scheduler of claim 69 wherein the physical layer logic includes an output transmitter adapted to transmit data parcels over the first communication line.

78. The scheduler of claim 69 wherein the first communication line corresponds to a communication line utilizing an ATM protocol; and

wherein the filler data parcels correspond to ATM idle cells.

79. The scheduler of claim 69 wherein the first communication line corresponds to a communication line utilizing a frame relay protocol; and

wherein the filler data parcels correspond to disposable frames which include predefined flag bytes.

80. The scheduler of claim 69 wherein the data parcels correspond to data parcels selected from a group consisting of ATM cells, frame relay frames, and IP packets.

81. The scheduler of claim 69 wherein the at least one client process further includes a second client process having an associated third bit rate different from that of the second bit rate; and

the scheduler being further configured or designed to identify incoming client data parcels from the second client process; and

wherein the output data stream further includes client data parcels from the second client process.

82. A system for scheduling data parcels from at least one client process to be output for transmission over a first communication line, the first communication line having an associated first bit rate, the at least one client process including a first client process having an associated second bit rate, the system comprising:

means for identifying a plurality of client data parcels associated with the first client process;

scheduling means in communication with the identifying means for scheduling selected client data parcels to be included in an output stream to be provided to physical layer logic for transmission over the first communication line;

means for determining an appropriate ratio of filler data parcels to be inserted into the output stream, said filler data parcels including non-meaningful data; and

means for generating the output stream;

wherein the output stream includes client data parcels and filler data parcels.

83. The system of claim 82 wherein said determining means includes means for determining an appropriate ratio of filler data parcels to be inserted into the scheduling means output stream to thereby cause a bit rate of the output stream to be substantially equal to the first bit rate.

84. The system of claim 82 wherein the output stream includes a uniform pattern of client data parcels and filler data parcels.

85. The system of claim 82 wherein the output stream includes a uniform pattern of client data parcels and filler data parcels; and

wherein the system further comprises repeating the uniform pattern of client data parcels and filler data parcels on a periodic basis.

86. The system of claim 82 wherein the physical layer logic includes an output transmitter adapted to transmit data parcels over the first communication line.

87. The system of claim 82 further comprising means for continuously transmitting a continuous stream bits over the first communication line during normal operation of the communication line.

88. The system of claim 82 wherein the first communication line corresponds to a communication line utilizing an ATM protocol; and

wherein the filler data parcels correspond to ATM idle cells.

89. The system of claim 82 wherein the first communication line corresponds to a communication line utilizing a frame relay protocol; and

wherein the filler data parcels correspond to disposable frames which include predefined flag bytes.

90. The system of claim 82 wherein the data parcels correspond to data parcels selected from a group consisting of ATM cells, frame relay frames, and IP packets.

91. The system of claim 82 wherein said scheduling means includes means for prioritizing client data parcels based upon quality of service (QoS) parameters associated with each client data parcel.

92. The system of claim 82 wherein the scheduling means is devoid of an internal clock source.

93. The system of claim 82 wherein the scheduling operations performed by the scheduling means are not based on an internal time reference.

94. The system of claim 82 wherein the at least one client process further includes a second client process having an associated third bit rate different from that of the second bit rate; and

wherein the system further comprises means for identifying incoming client data parcels from the second client process; and

wherein the output data stream further includes client data parcels from the second client process.--

All pending claims have been reproduced below for the convenience of the Examiner.

REMARKS

Applicants believe that all pending claims are allowable and respectfully requests a Notice of Allowance for this application from the Examiner. Should the Examiner believe that a telephone conference would expedite the prosecution of this application, the undersigned can be reached at the telephone number set out below.

Respectfully submitted,
BEYER WEAVER & THOMAS, LLP

Dean E. Wolf
Reg. No. 37,260

P.O. Box 778
Berkeley, CA 94704-0778
(510) 843-6200

APPENDIX OF PENDING CLAIMS

1. A method for scheduling data parcels from at least one client process to be output for transmission over a first communication line, the first communication line having an associated first bit rate, the at least one client process including a first client process having an associated second bit rate, the method comprising:

identifying, at a scheduler, a plurality of client data parcels associated with the first client process;

scheduling selected client data parcels to be included in an output stream provided to physical layer logic for transmission over the first communication line;

determining an appropriate ratio of filler data parcels to be inserted into the output stream, said filler data parcels including non-meaningful data; and

generating the output stream;

wherein the output stream includes client data parcels and filler data parcels.

2. The method of claim 1 wherein said determining includes determining an appropriate ratio of filler data parcels to be inserted into the output stream to thereby cause a bit rate of the output stream to be substantially equal to the first bit rate.

3. The method of claim 1 wherein the output stream includes a uniform pattern of client data parcels and filler data parcels.

4. The method of claim 1 wherein the output stream includes a uniform pattern of client data parcels and filler data parcels; and

wherein the method further comprises repeating the uniform pattern of client data parcels and filler data parcels on a periodic basis.

5. The method of claim 1 wherein the physical layer logic includes an output transmitter adapted to transmit data parcels over the first communication line.

6. The method of claim 1 further comprising continuously transmitting a continuous stream bits over the first communication line during normal operation of the communication line.

7. The method of claim 1 wherein the first communication line corresponds to a communication line utilizing an ATM protocol; and

wherein the filler data parcels correspond to ATM idle cells.

8. The method of claim 1 wherein the first communication line corresponds to a communication line utilizing a frame relay protocol; and

wherein the filler data parcels correspond to disposable frames which include predefined flag bytes.

9. The method of claim 1 wherein the data parcels correspond to data parcels selected from a group consisting of ATM cells, frame relay frames, and IP packets.

10. The method of claim 1 wherein said scheduling includes prioritizing client data parcels based upon quality of service (QoS) parameters associated with each client data parcel.

11. The method of claim 1 wherein the scheduling operations are performed by the scheduler without the use of an internal clock source.

12. The method of claim 1 wherein the scheduling operations performed by the scheduler are not based on an internal time reference.

13. The method of claim 1 wherein the at least one client process further includes a second client process having an associated third bit rate different from that of the second bit rate; and

wherein the method further comprises:

identifying incoming client data parcels from the second client process; and

wherein the output data stream further includes client data parcels from the second client process.

14. A computer program product for scheduling data parcels from at least one client process to be output for transmission over a first communication line, the first communication line having an associated first bit rate, the at least one client process including a first client process having an associated second bit rate, the computer program product comprising:

a computer usable medium having computer readable code embodied therein, the computer readable code comprising:

computer code for identifying a plurality of client data parcels associated with the first client process;

computer code for scheduling selected client data parcels to be included in an output stream to be provided to physical layer logic for transmission over the first communication line;

computer code for determining an appropriate ratio of filler data parcels to be inserted into the output stream, said filler data parcels including non-meaningful data; and

computer code for generating the output stream;

wherein the output stream includes client data parcels and filler data parcels.

15. The computer program product of claim 14 wherein said determining computer code includes computer code for determining an appropriate ratio of filler data parcels to be inserted into the output stream to thereby cause a bit rate of the output stream to be substantially equal to the first bit rate.

16. The computer program product of claim 14 wherein the output stream includes a uniform pattern of client data parcels and filler data parcels.

17. The computer program product of claim 14 wherein the output stream includes a uniform pattern of client data parcels and filler data parcels; and

wherein the computer program product further comprises repeating the uniform pattern of client data parcels and filler data parcels on a periodic basis.

18. The computer program product of claim 14 wherein the physical layer logic includes an output transmitter adapted to transmit data parcels over the first communication line.

19. The computer program product of claim 14 further comprising computer code for continuously transmitting a continuous stream bits over the first communication line during normal operation of the communication line.

20. The computer program product of claim 14 wherein the first communication line corresponds to a communication line utilizing an ATM protocol; and

wherein the filler data parcels correspond to ATM idle cells.

21. The computer program product of claim 14 wherein the first communication line corresponds to a communication line utilizing a frame relay protocol; and

wherein the filler data parcels correspond to disposable frames which include predefined flag bytes.

22. The computer program product of claim 14 wherein the data parcels correspond to data parcels selected from a group consisting of ATM cells, frame relay frames, and IP packets.

23. The computer program product of claim 14 wherein said scheduling computer code includes computer code for prioritizing client data parcels based upon quality of service (QoS) parameters associated with each client data parcel.

24. The computer program product of claim 14 wherein the scheduling operations performed by the scheduling computer code are not performed using an internal time reference signal.

25. The computer program product of claim 14 wherein the at least one client process further includes a second client process having an associated third bit rate different from that of the second bit rate; and

wherein the computer program product further comprises computer code for identifying incoming client data parcels from the second client process; and

wherein the output data stream further includes client data parcels from the second client process.

26. A system for scheduling data parcels from at least one client process to be output for transmission over a first communication line, the first communication line having an associated first bit rate, the at least one client process including a first client process having an associated second bit rate, the system comprising:

a scheduler adapted to identify incoming client data parcels from the first client process, and to generate an output stream of data parcels to be provided to physical layer logic for transmission over the first communication line;

the scheduler being configured or designed to generate filler data parcels which include non-meaningful data;

the scheduler being further configured or designed to determine an appropriate ratio of filler data parcels to be inserted into the scheduler output stream.

27. The system of claim 26 wherein the scheduler is further configured or designed to determine an appropriate ratio of filler data parcels to be inserted into the scheduler output stream to thereby cause a bit rate of the scheduler output stream to be substantially equal to the first bit rate.

28. The system of claim 26 wherein the scheduler output stream includes both client data parcels which include meaningful data and filler data parcels which do not include meaningful data.

29. The system of claim 26 wherein the scheduler output stream includes a uniform pattern of client data parcels and filler data parcels.

30. The system of claim 26 wherein the scheduler output stream includes a uniform pattern of client data parcels and filler data parcels, the uniform pattern being repeated on a periodic basis.

31. The system of claim 26 wherein the physical layer logic includes an output transmitter adapted to transmit data parcels over the first communication line.

32. The system of claim 26 wherein the first communication line is adapted to utilize a communication protocol which requires a continuous stream of bits to be transmitted over the first communication line during normal operation of the communication line.

33. The system of claim 26 wherein the first communication line corresponds to a communication line utilizing an ATM protocol; and

wherein the filler data parcels correspond to ATM idle cells.

34. The system of claim 26 wherein the first communication line corresponds to a communication line utilizing a frame relay protocol; and

wherein the filler data parcels correspond to disposable frames which include predefined flag bytes.

35. The system of claim 26 wherein the data parcels correspond to data parcels selected from a group consisting of ATM cells, frame relay frames, and IP packets.

36. The system of claim 26 further comprising:

quality of service (QoS) scheduling logic;

ratio computation component (RCC) logic in communication with the QoS scheduling logic, the RCC logic being configured or designed to compute an appropriate ratio of meaningful data parcels to non-meaningful data parcels.

37. The system of claim 26 wherein the scheduler is devoid of an internal clock source.

38. The system of claim 26 wherein scheduling operations performed by the scheduler are not based on an internal time reference.

39. The system of claim 26 wherein the at least one client process further includes a second client process having an associated third bit rate different from that of the second bit rate; and

wherein the scheduler is further adapted to identify incoming client data parcels from the second client process, and to generate an output stream of data parcels to physical layer logic for transmission over the first communication line;

wherein the output data stream includes client data parcels from the first and second client processes.

40-68 Cancelled

69. A scheduler for scheduling data parcels from at least one client process to be output for transmission over a first communication line, the first communication line having an associated first bit rate, the at least one client process including a first client process having an associated second bit rate;

the scheduler being adapted to identify incoming client data parcels from the first client process, and to generate an output stream of data parcels to physical layer logic for transmission over the first communication line;

the scheduler being configured or designed to generate filler data parcels which include non-meaningful data.

70. The scheduler of claim 69 wherein the scheduler is devoid of an internal clock source.

71. The scheduler of claim 69 wherein the scheduler includes an ATM cell switch.

72. The scheduler of claim 69 further comprising:

quality of service (QoS) scheduling logic;

ratio computation component (RCC) logic in communication with the QoS scheduling logic, the RCC logic being configured or designed to compute an appropriate ratio of meaningful data parcels to non-meaningful data parcels.

73. The scheduler of claim 69 being further configured or designed to identify a plurality of client data parcels associated with the first client process;

the scheduler being further configured or designed to schedule selected client data parcels to be included in an output stream to be provided to physical layer logic for transmission over the first communication line;

the scheduler being further configured or designed to determine an appropriate ratio of filler data parcels to be inserted into the output stream, said filler data parcels including non-meaningful data; and

the scheduler being further configured or designed to generate the output stream;

wherein the output stream includes client data parcels and filler data parcels.

74. The scheduler of claim 73 wherein said determine means includes the scheduler being further configured or designed to determine an appropriate ratio of filler data parcels to be inserted into the output stream to thereby cause a bit rate of the output stream to be substantially equal to the first bit rate.

75. The scheduler of claim 69 wherein the output stream includes a uniform pattern of client data parcels and filler data parcels.

76. The scheduler of claim 69 wherein the output stream includes a uniform pattern of client data parcels and filler data parcels; and

wherein the scheduler further comprises repeating the uniform pattern of client data parcels and filler data parcels on a periodic basis.

77. The scheduler of claim 69 wherein the physical layer logic includes an output transmitter adapted to transmit data parcels over the first communication line.

78. The scheduler of claim 69 wherein the first communication line corresponds to a communication line utilizing an ATM protocol; and

wherein the filler data parcels correspond to ATM idle cells.

79. The scheduler of claim 69 wherein the first communication line corresponds to a communication line utilizing a frame relay protocol; and

wherein the filler data parcels correspond to disposable frames which include predefined flag bytes.

80. The scheduler of claim 69 wherein the data parcels correspond to data parcels selected from a group consisting of ATM cells, frame relay frames, and IP packets.

81. The scheduler of claim 69 wherein the at least one client process further includes a second client process having an associated third bit rate different from that of the second bit rate; and

the scheduler being further configured or designed to identify incoming client data parcels from the second client process; and

wherein the output data stream further includes client data parcels from the second client process.

82. A system for scheduling data parcels from at least one client process to be output for transmission over a first communication line, the first communication line having an associated first bit rate, the at least one client process including a first client process having an associated second bit rate, the system comprising:

means for identifying a plurality of client data parcels associated with the first client process;

scheduling means in communication with the identifying means for scheduling selected client data parcels to be included in an output stream to be provided to physical layer logic for transmission over the first communication line;

means for determining an appropriate ratio of filler data parcels to be inserted into the output stream, said filler data parcels including non-meaningful data; and

means for generating the output stream;

wherein the output stream includes client data parcels and filler data parcels.

83. The system of claim 82 wherein said determining means includes means for determining an appropriate ratio of filler data parcels to be inserted into the scheduling means output stream to thereby cause a bit rate of the output stream to be substantially equal to the first bit rate.

84. The system of claim 82 wherein the output stream includes a uniform pattern of client data parcels and filler data parcels.

85. The system of claim 82 wherein the output stream includes a uniform pattern of client data parcels and filler data parcels; and

wherein the system further comprises repeating the uniform pattern of client data parcels and filler data parcels on a periodic basis.

86. The system of claim 82 wherein the physical layer logic includes an output transmitter adapted to transmit data parcels over the first communication line.

87. The system of claim 82 further comprising means for continuously transmitting a continuous stream bits over the first communication line during normal operation of the communication line.

88. The system of claim 82 wherein the first communication line corresponds to a communication line utilizing an ATM protocol; and

wherein the filler data parcels correspond to ATM idle cells.

89. The system of claim 82 wherein the first communication line corresponds to a communication line utilizing a frame relay protocol; and

wherein the filler data parcels correspond to disposable frames which include predefined flag bytes.

90. The system of claim 82 wherein the data parcels correspond to data parcels selected from a group consisting of ATM cells, frame relay frames, and IP packets.

91. The system of claim 82 wherein said scheduling means includes means for prioritizing client data parcels based upon quality of service (QoS) parameters associated with each client data parcel.

92. The system of claim 82 wherein the scheduling means is devoid of an internal clock source.

93. The system of claim 82 wherein the scheduling operations performed by the scheduling means are not based on an internal time reference.

94. The system of claim 82 wherein the at least one client process further includes a second client process having an associated third bit rate different from that of the second bit rate; and

wherein the system further comprises means for identifying incoming client data parcels from the second client process; and

wherein the output data stream further includes client data parcels from the second client process.

of the present invention and conventional scheduling techniques, it is helpful to review the process by which idle cells are generated in conventional scheduling techniques.

It will be appreciated that conventional schedulers are not configured to generate idle cells. Rather, according to conventional scheduling techniques, the generation of idle cells is handled by the physical layer such as the output transceiver componentry 110. For example, if there are data cells queued in the transmitter FIFO 112, the output transceiver 114 will dequeue the cells from buffer 112 at fixed periodic intervals, and transmit the dequeued data cells over line 109. However, if the output transceiver determines that it is time to transmit a next ATM cell over line 109, and the buffer 112 is empty, the output transceiver will generate and transmit an idle cell over line 109 at the designated time. Thus, it will be appreciated that, in conventional scheduling techniques, the ATM transceiver is responsible for the generation of idle cells. Additionally, it will be appreciated that, since the clock sources driving each of the schedulers are typically not synchronized, a non-uniform pattern of data/idle cells is transmitted from the output transceiver 114 over line 109. Such a non-uniform pattern of data/idle cells makes it difficult to perform system analysis measurements for verifying proper operation of the various system components.

In contrast to conventional scheduling techniques which utilize an internal time base for scheduling and clocking output data from different client processes into the output transceiver buffer, the scheduling technique of the present invention determines an appropriate ratio of data cells and idle cells for each client process, and effectively achieves proper scheduling and timing functionality by periodically inserting an appropriate number of idle cells into the output data stream associated with a selected client process.

According to a specific embodiment as shown, for example, in FIGURE 2 of the drawings, the scheduler 204 is configured to service a plurality of different client processes which may have different associated line rates. The client processes store their output data cells in output buffers 202A, 202B. As shown in the embodiment of FIGURE 2, the scheduler 204 includes a ratio computation component (RCC) 206 which may be configured to perform functions for determining the appropriate ratio of idle cells to be inserted into the output data stream(s) of selected client processes in